

134

Quantitative assessment of left ventricular function by 2D-speckle tracking during exercise: a feasibility study

Catherine Szymanski [Orateur] (1), Marco Campana (2), Julien Magne (3), Monica Rosca (3), Luc Piérard (3), Patrizio Lancellotti (3)
(1) *University Hospital Sart Tilman – Department of cardiology, Heart Valve Disease Clinic, Liège, Belgique* – (2) *Heart Surgery Unit, Poliam-bulanza Foundation Hospital, Brescia, Italie* – (3) *Department of cardio-logy, Heart Valve Disease Clinic, CHU Sart Tilman, Liège, Belgique*

Objectives: To study the feasibility of quantifying left ventricular (LV) function by 2D-speckle tracking of myocardial deformation during exercise echocardiography in normal subjects.

Background: Accurate assessment of LV functional reserve during stress testing is challenging. For this purpose, the value of LV ejection fraction is limited. 2D-speckle tracking allows accurate quantification of LV regional function at rest. However, no study has evaluated the exercise-induced changes in myocardial deformation in normal subjects.

Methods: Fifty-three consecutive normal subjects underwent quantitative assessment of LV function using 2D-speckle tracking at rest and during a semi-supine graded exercise echocardiography. All strain and LV rotation parameters were measured at rest and at exercise to assess longitudinal strains in apical views and radial strains in parasternal short-axis view.

Results: During test, LV ejection fraction increased significantly from rest to peak exercise ($64.3 \pm 5.6\%$ vs $74.6 \pm 6.4\%$; $p < 0.0001$) whereas LV end-systolic volume decreased ($p < 0.001$). All strains parameters of myocardial deformation (longitudinal $20.1 \pm 2.8\%$ to $24.6 \pm 3.6\%$, $p < 0.0001$, radial $48.4 \pm 12.8\%$ to $60.3 \pm 10.2\%$, $p < 0.001$) increased during exercise. Changes in LV ejection fraction during exercise were well correlated with changes in longitudinal function ($R^2 = 0.379$, $p = 0.018$). LV apex rotation and rotation rate also increased during test (11.5 ± 3.8 to 21.8 ± 2.5 deg, $p < 0.0001$ and 122.2 ± 47.7 to 209.5 ± 41.9 deg s^{-1} ; $p = 0.0001$ respectively for rotation and rotation rate). Intra- and inter-observer agreements for strain measurements were good. The variability between observers ranged from 0.5 to 6.4%.

Conclusion: Evaluation of LV function by 2D-speckle tracking during exercise is feasible. This method can thus be used to accurately assess LV functional reserve during stress.

135

Assessment of left ventricular function by real-time three-dimensional speckle tracking echocardiography compared to magnetic resonance imaging

Camille Brémont [Orateur], Laurent Macron, Delphine Hayat, Alexandre Bensaid, Jean-Luc Dubois-Randé, Pascal Guéret, Pascal Lim
AP-HP, CHU Henri Mondor, Cardiologie, Créteil, France

Aims: Real-time three-dimensional speckle tracking (3DST) echocardiography has recently been proposed to improve left ventricular myocardial function assessment. To evaluate its accuracy, we investigated the correlation between 3DST data and left ventricular ejection fraction (LVEF) obtained by magnetic resonance imaging (MRI).

Methods: 37 patients (56 \pm 15 years old, 26 men) referred for LVEF assessment by MRI, underwent on the same day real-time 3D-echocardiography. LV volumes, LVEF and 3D strain components (longitudinal, radial, and circumferential strains) were computed by a 3D-speckle tracking software using multi-beat 3D datasets.

Results: A close correlation between MRI and 3DST was observed for end diastolic ($r^2 = 0.7$, mean = 130 ± 62 mL), end-systolic (88 ± 72 mL, $r^2 = 0.8$) volumes and LVEF ($r^2 = 0.7$, mean = $52 \pm 16\%$). No significant bias was observed between MRI and 3D-speckle tracking for LVEF measurement ($52 \pm 16\%$ vs. $51 \pm 14\%$, $p = 0.6$). In addition, all strain data obtained by 3DST correlated with LVEF by MRI [$r = 0.5$ for longitudinal strain, $r = 0.6$ for radial strain, and $r = 0.7$ for circumferential strain].

Conclusion: Real time 3D-speckle tracking provides a reliable assessment of LV volumes and ejection fraction compared to MRI data, with a comprehensive measurement of myocardial deformation indexes.

136

Relative importance of the afterload and of myocardial disarray on left ventricular longitudinal function. A rest and standardized exercise study

Frederic Schnell [Orateur], Erwan Donal, Anne Bernard, Gaelle Kervio, Philippe Mabo, François Carre
CHU Rennes, Cardiologie, Rennes, France

Background: Hypertrophic cardiomyopathy (HCM) and aortic stenosis (AS) may impact left ventricular (LV) systolic functions despite preservation of the LV ejection fraction (EF). Studies have especially demonstrated in these two populations a decrease in LV longitudinal function.

AIMS: We sought to determine the relative importance of the afterload and of myocardial hypertrophy (& disarray) on LV longitudinal potential dysfunction at rest and during a standardized exercise.

Methods: Consecutive patients with a severe (< 1.5 cm²) asymptomatic AS and patients with a HCM were explored according to the same protocol by a rest and exercise echocardiography. A complete echocardiography including tissue Doppler was performed at rest and during the exercise on a dedicated table. Furthermore, long-axis function was assessed at rest and at exercise by using deformation imaging (2D-strain). Exclusion criteria were: altered LVEF ($< 50\%$), coronaropathy, intra-L obstruction > 30 mmHg at rest, arrhythmia, diastolic LV thickness ≥ 30 mm, NYHA $> II$.

From these two populations, we selected 25 patients appaired in age, sexe, rest and exercise blood pressure, degree of LV hypertrophy and LVEF.

Results: The mean age was, the mean blood pressure was and the work-load reached during the exercise stress echocardiography was. The inter ventricular septum diastolic thickness was 1.45 ± 0.2 mm in AS vs. 1.55 ± 0.2 mm in HCM ($p = 0.053$). Global longitudinal strain (GLS) was at rest $-14.9 \pm 4.7\%$ in AS vs. $-16.1 \pm 3.9\%$ in HCM ($p = 0.30$). At 110 ± 10 beat/min, the SGL was $-14.1 \pm 4.2\%$ in AS vs. $-18.1 \pm 5.4\%$ in HCM ($p = 0.005$), during exercise GLS decreased in AS but increased in HCM (Δ GLS $0.77 \pm 3.1\%$ in AS vs $-1.94 \pm 3.37\%$ in HCM).

Conclusion: Longitudinal LV deformations, during the exercise, were very significantly lower in AS-patients as compare to HCM-ones despite very close characteristics at rest. The greater afterload in AS patient might explain this different LV-myocardial response to exercise in these 2 groups of patients having very closed LV-myocardial function at rest.

137

A novel method for automatic quantification of late gadolinium enhancement in acute myocarditis

Emmanuelle Vermes [Orateur], Helene Childs, Iacopo Carbone, Philipp Barckow, Matthias Friedrich
Stephenson Centre, Calgary, Canada

Purpose: Late gadolinium enhancement sequence is a robust technique for detection of fibrosis in acute myocarditis. However, there is no consensus regarding the quantification of LGE in myocarditis. Some centers use visual assessment; some others use signal intensity thresholds of 2 or more standard deviations (SD). This method is semi-automatic needing to trace manually a remote myocardium. The Otsu-Auto-Threshold (OAT) method is based on the so-called Otsu algorithm, which automatically divides the histogram into two "classes", normal and enhanced, and automatically calculates a threshold which best separates the two classes, minimizing intra-class variance. No specific region within the myocardium has to be defined as normal or abnormal. The purpose of this study was to compare these and standard-deviation based thresholds for automatic quantification methods of LGE in acute myocarditis.

Methods: CMR was performed in 30 patients with acute myocarditis. LGE was quantified by visual assessment (as a reference method) and compared to OAT, full-width-half-max (FWHM) and thresholds using 2SD, 3SD and 5SD above mean SI of remote myocardium. The total enhanced mass was measured by all approaches for each patient.

Results: The mean mass of LGE with visual assessment was 16.5 ± 10.4 g. All methods were significantly correlated with visual assessment with a very strong correlation with the OAT method ($r = 0.976$,

$p < 0.0001$). There was no significant difference in enhanced mass as assessed with OAT (16.3 ± 9.8 g $p = 0.451$). In contrast, all other methods provided significant differences in the mean total LGE mass. Thresholds using 2SD and 3SD caused a 46% and 19% overestimation of LGE mass, respectively. Thresholds using 5SD and FWHM lead to an underestimation of 17% and 26% respectively.

Conclusion: Our results suggest that, in patients with acute myocarditis, the Otsu auto-threshold method provides the best agreement with the visual assessment and may serve as a valuable method to automatically quantify myocardial fibrosis.

138

Assessment of left ventricular twist mechanics in tako-tsubo cardiomyopathy by two-dimensional speckle tracking echocardiography

Patrick Meimoun [Orateur] (1), Pricila Passos (1), Tahar Benali (1), Jacques Boulanger (1), Frederic Elmkies (2), Hamdane Zemir (2), Jerome Clerc (1), Anne Luyck-Bore (1)

(1) CH Compiègne, Cardiologie-USIC, Compiègne, France – (2) CH Compiègne, Compiègne, France

Purpose: to assess left ventricular (LV) twist mechanics (TM) in patients (pts) with tako-tsubo cardiomyopathy (TTC). **Methods:** LV TM by speckle tracking echocardiography was performed in 16 consecutive pts with typical TTC (78 ± 8 years, 94% women, and mean LVEF $46 \pm 10\%$), at the acute phase (within 24 h after admission) and after recovery. Sixteen control (C) pts matched for age and sex (mean LVEF $70 \pm 7\%$), and 16 pts with acute anterior myocardial infarction (MI) treated by successful primary angioplasty 24 h before, matched for LVEF and sex, were compared to TTC pts. LV twist was assessed using the parasternal basal and apical short-axis planes, and defined as the net difference in degrees of apical (Ar) and basal rotation (Br). Peak systolic and early diastolic, apical (As and Ad) and basal (Bs and Bd) rotation rate, and LV twisting rate (TR) and untwisting rate (UR) (in $^\circ/\text{s}$) were derived from rotational and twist curves.

Results: At the acute phase, Ar ($5 \pm 5^\circ$ vs. $15 \pm 4^\circ$), As, Ad, Bs, LV twist, LVTR, and LVUR, were significantly impaired in patients with TTC when compared to C (all, $p < 0.05$). Pts with MI displayed intermediate values ($p = \text{NS}$ vs. TTC, and $p < 0.05$ vs. C). However, in the subgroup of pts with ECG ST-segment elevation at presentation ($n = 27$), several LV TM parameters were significantly reduced in TTC pts when compared to MI pts, LV twist and LVTR being the best discriminative tools (all, $p \leq 0.01$). Abnormal reversed apical rotation (clockwise when seen from the apex) was seen in 3 pts (19%) with TTC vs. none in the other groups. A significant correlation between LV twist and LVEF, LV volumes, wall motion score, and NT-pro BNP was observed in the TTC group (all, $p < 0.05$). At follow-up, LV TM improved significantly in TTC pts (all, $p < 0.05$ vs. acute phase), who had final values similar to C (all, $p = \text{NS}$), whereas the magnitude of improvement was lower in MI pts ($p \leq 0.05$ vs. TTC).

Conclusion: LV TM is significantly impaired in pts with TTC mainly due to a severe reduction of apical function and is entirely reversible. Furthermore, the acute evaluation of LV TM allows the differentiation between TTC and MI in pts with ST-segment elevation.

139

Measurement of the left atrium volume does the method matter?

Nadia Berjeb [Orateur], Claire Cimadevilla, Julien Dreyfus, Caroline Cuff, Michaela Malanca, Andrea Chiampan, Alec Vahanian, David Mes-sika-Zeitoun

AP-HP, Hôpital Bichat-Claude-Bernard, Cardiologie, Paris, France

Background: Several echocardiographic methods can be used to assess the left atrium (LA) volume. They provide different results and recommended threshold to define LA enlargement are different. We aimed at evaluating the agreement between methods for the assessment of the degree of LA enlargement.

Method: We prospectively measured LA volume in 70 healthy subjects using 4 methods: cube, ellipsoid, biplane Simpson and biplane area-length (A/L). Threshold for LA enlargement and severe LA enlargement were mean+2SD and mean+4SD. LA volume was also prospectively measured using the 4 methods in 371 consecutive patients referred for clinically indicated echocardiography. Agreement between methods for the degree of LA enlargement (normal, moderately and severely enlarged) was assessed by the Kappa value. The A/L method was used as reference.

Results: Normal values of LA volume using the 4 different methods and thresholds for LA enlargement are presented in the table. In the 371 patients, LA volume using the 4 methods (cube, ellipsoid, biplane Simpson and biplane A/L) were respectively 29 ± 19 , 47 ± 27 , 61 ± 33 and 65 ± 37 ml/m². As expected LA volumes were significantly different ($p < 0.001$) but agreement between the method of cube, ellipsoid, and biplane Simpson with the A/L was also modest (kappa 0.41, 0.66 and 0.68 respectively) and the percentage of the misclassified patients was 58%, 22% and 22%.

Conclusion: Not only LA volume values are different according to the method used but also assessments of the degree of LA enlargement are poorly correlated. These results may have important implications in the management of patients and the indication for anticoagulation therapy.

Table – Left atrial value in the healthy population and threshold for moderate and severe enlargement

METHOD	Cube method	Ellipsoid method	Biplane Simpson method of Discs	Biplane-Area Length method
Mean \pm SD ml/m ²	11 ± 4	22 ± 6	26 ± 6	28 ± 8
LA enlargement ml/m ²	-19	-34	-38	-44
Severe LA enlargement ml/m ²	-27	-46	-50	-60

140

Assessment of left main coronary artery lesions by 64 slices coronary tomography: comparison with IVUS and quantitative coronary angiogram

Anne Bellemain-Appaix [Orateur] (1), Christophe Caussin (2), Farzin Beygui (3), Johanne Silvain (3), Olivier Barthélémy (3), David Pesenti-Rossi (2), Said Ghosline (2), Jean-Philippe Collet (3), Gilles Montalescot (3)

(1) Centre de Réadaptation Cardiaque, Vence, France – (2) Centre Chirurgial Marie Lannelongue, Le Plessis Robinson, France – (3) AP-HP, CHU Pitié Salpêtrière, Paris, France

Background: Assessment of left main (LM) stenosis is challenging, and consequences are important. FFR-0.75 and IVUS (MLA-6mm²) have been correlated to significant LM stenosis.

Objectives: To assess sensitivity, specificity, positive and negative predictive values (PPV and NPV) of multislice coronary tomography (MSCT) for LM lesions using IVUS as a reference.

Methods: 50 patients who underwent successive 64 slices CT, QCA and IVUS were included. We determined plaque size, area, minimal lumen area and diameter (MLA, MLD), calcifications, location, and %stenosis according current guidelines.

Results: 22% patients had significant LM stenosis (IVUS (MLA-6mm²)). MSCT was accurate for lesion location (kappa=0.7040), for calcifications (Se=94.74%, Spe=64.52%, PPV=62.1%, NPV=95.24%). MLD ($r = 0.511$, $p = 0.0009$), %MLD ($r = 0.428$, $p = 0.0145$) and MLA ($r = 0.4035$, $p = 0.0109$). Best cut-off values of MSCT for significant stenosis were MLA ≤ 8.3 mm² and MLD ≤ 2.7 mm (combined sensitivity=90%, specificity=65.5%, PPV=47.4%, NPV=95%). There was good interobserver agreement (MLA: $r = 0.84$, MLD: $r = 0.898$, $p < 0.0001$). Table 1 shows comparisons between QCA, MSCT and IVUS.

Conclusion: MSCT is accurate for LM evaluation and might provide reliable alternative to more invasive assessment.